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Original Article

Psychometric properties and population-based score distributions of the Japanese Sleep Questionnaire for Preschoolers

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ABSTRACT

Objective: We aimed to present psychometric properties and describe the score distributions of the Japanese Sleep Questionnaire for Preschoolers (JSQ-P), a guardian-reported survey questionnaire for assessing sleep disturbances and problematic sleep habits among preschool children.
Methods: Guardians of 2998 toddlers in three communities and guardians of 102 patients diagnosed with sleep disorders in two clinics completed the JSQ-P.
Results: Exploratory factor analysis (EFA) revealed the 10 domains of the JSQ-P to be similar to our previous small-scale study and confirmed the robustness of the JSQ-P. The JSQ-P showed acceptable internal consistency; α coefficients ranged from 0.622 (insufficient sleep) to 0.912 (restless legs syndrome [RLS], motor) for the community sample and 0.696 (insufficient sleep) to 0.959 (RLS, motor) for the clinical sample. The score differentiations between the community and clinical samples associated with RLS, obstructive sleep apnea syndrome (OSAS), morning symptoms, parasomnias, excessive daytime sleepiness, and daytime behaviors were demonstrated in our study. The distributions of percentile T scores for each subscale and age and gender differentiation of scores also were evaluated.
Conclusions: We confirmed that the JSQ-P is a valid and reliable instrument to evaluate Japanese sleep habits using a large population-based sample. The JSQ-P may be useful in both clinical and academic settings.

1. Introduction

Sleep disturbances are common in children, ranging from 25% to 40% among preschool-aged children and adolescents [1–3]. According to a questionnaire-based study among children aged 6 months to 6 years, obstructive sleep apnea syndrome (OSAS) was estimated to affect at least 1–3% [4]. Moreover, the prevalence of restless legs syndrome (RLS) is reported to be 1.9% in children ages 8–11 years [5]. However, sleep problems in children remain underrecognized at the primary care level despite the relatively high prevalence of sleep disorders [6–9].

Sleep disturbances can have a profound effect on children. Studies have described the association between insufficient sleep and behavioral and affective disorders, as well as suboptimal school performance secondary to impairment of attention [10,11]. In addition, sleep disturbances may be misconstrued as possible cognitive impairment [12]. Touchette et al. [13] also reported that children between the ages of 2 and 6 years who had short sleep duration patterns were more likely to demonstrate hyperactivity impulsiveness and lower cognitive performance at the age of 6 years. Therefore, early identification and management of children with sleep problems may prevent future functional impairment.

Several screening questionnaires for sleep disturbances have been developed for clinical and research purposes in Western countries. Owens et al. [14] introduced the Children's Sleep Habit Questionnaire (CSHQ), a parent- or guardian-reported questionnaire probing problematic sleep domains in school-aged children between the ages of 4 and 10 years. The CSHQ constitutes 35 items divided into eight domains: bedtime resistance, sleep-onset delay, sleep anxiety, night waking, parasomnias, sleep-disordered breathing, and daytime sleepiness. It has been commonly used in Western countries [15,16] but also in Asia, including Japan [17–19]. Goodlin-Jones et al. [20] also reported on the validity of the CSHQ

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in toddlers and preschool children aged 2–5.5 years. Similarly the Sleep Disturbance Scale for Children [21], Pediatric Sleep Questionnaire [22], and Omnibus Sleep Problems Questionnaire for School-aged Children [23] also have been used to assess sleep problems in children.

However, these instruments were originally developed in consideration of the Western sleep culture and may not be entirely appropriate for the Japanese sleeping conditions and sleep culture. First, Japanese children have been described to have poor sleep habits, including delayed sleep onset and short sleep duration compared to other countries [24]. A recent cross-cultural study also reported that the sleep duration of children in Japan was the shortest among 17 countries [25]. In addition, parents were less likely to regard these situations as serious [24]. This relatively low consideration of sleep hygiene can potentially produce unique sleep characteristics in Japan. Second, there are cultural differences in sleep environments. Based on the National Survey, approximately half of all young individuals including children sleep on a Japanese-style bed called a futon, which is a thin mattress made of a cotton pad, placed directly on the floor [26]. Sleeping on a futon facilitates the movement to another individual's futon. Moreover, bed or room sharing is more prevalent in Japan compared to other countries, particularly in toddlers and preschool children [27]. Children who sleep in their own rooms account for only 3% in Japan, with 88% reportedly sleeping in their parents' room [24]. Thus these unique Japanese sleeping habits and conditions require a sleep culture assessment different from the Western questionnaires.

We recently developed a valid and reliable questionnaire to screen for signs of sleep disorders and problematic sleep habits, which can be easily applied to Japanese preschool children [28]. In our study, research clinicians with extensive experience in assessing and treating pediatric sleep disorders constructed 76 items based on preexisting questionnaires, such as the CSHQ and on the *International Classification of Sleep Disorders*, second edition (ICSD-2). Items included symptoms of sleep disorders, such as OSAS and RLS, as well as sleep habits. When designing the initial questionnaire, clinicians and researchers asked 10 parents or guardians of children with sleep disorders and eight women ages 22–40 years to ensure that the sentences were correct and were not awkwardly phrased. Participants completed our questionnaire by rating on 6-point frequency and 6-point intensity Likert scales. After considering missing values and the variance of responses, the 6-point intensity rating scale was chosen. Although other instruments typically are rated on a smaller number point frequency scale (e.g., CSHQ has a 3-point frequency rating), the Japanese culturally avoid explicit responses and tend to respond moderately. Thus a 6-point scale circumvented any midpoints and provided a suitable range of responses. To enhance the reliability and efficiency of the scales, items with extreme mean scores, high skewed values, a restricted range of responses, or a high number of missing data were removed from the initial pool of items. The remaining items were analyzed using exploratory factor analysis (EFA). The final 10 subscales consisting of 39 items were named the Japanese Sleep Questionnaire for Preschoolers (JSQ-P) and its reliability measured by α coefficient was 0.67–0.99 [28]. The validity was confirmed by a comparison of subscale scores of community and clinical samples.

The validity and reliability of the JSQ-P was evaluated in our previous study, but it was conducted on a small sample; in addition, the distribution of scores was not included due to a relatively small study population (community sample size, 86; clinical sample size, 32). To effectively apply questionnaire-based screening in clinical practice, information regarding standardized scores is essential. Therefore, our study aimed to: (1) examine the robustness of factor structure in a large sample, (2) test its reliability and concurrent validity, (3) describe the distribution of scores of the JSQ-P in Japanese preschool children, and (4) confirm the age and gender difference of the score distribution.

2. Methods

The study protocol and questionnaire were approved by the Human Research Ethics Committee of the Institutional Review Board at Osaka University Hospital.

2.1. Participants

All guardians provided informed consent for our study. Participants were enrolled from the community and clinics. The community group initially consisted of 2998 guardians of preschool-aged children. We recruited guardians from three different groups for our study: private kindergarten, nursery school, and recipients of regular physical examinations at the age of 3 years. The kindergarten sample was taken from a private kindergarten affiliated with the University in Tokyo, which likely reflected a higher socioeconomic status, according to the National Survey of Household Expenditure for Children's Education [29]. The nursery school sample was composed of children attending 19 public nursery schools located in Osaka, which typically consists of a low or middle socioeconomic class with a 2-income household. These two samples appeared to encompass all socioeconomic groups, but children who did not attend kindergarten or nursery school and instead remained with a stay-at-home parent were excluded. To eliminate this sample bias, we also conducted surveys when children received their physical examination. Our sample consisted of children who received government-regulated regular physical examinations at the age of 3 years, which were conducted by the public healthcare center in the Osaka prefecture.

The clinical group initially consisted of 102 preschool-aged children seeking treatment at the pediatric sleep clinics of Osaka University Hospital and Osaka Kaisei Hospital in Osaka, Japan. All participants met diagnostic criteria for either a primary or secondary diagnosis of sleep disorder, including OSAS, RLS, insomnia, nocturnal enuresis, and night terrors.

2.2. The Japanese Sleep Questionnaire for Preschoolers

The JSQ-P consists of 39 items classified into 10 domains according to psychometric condition, namely OSAS, RLS-sensory, RLS motor, morning symptoms, sleep habits, parasomnias, insufficient sleep, daytime excessive sleepiness, daytime behaviors, and insomnia or circadian rhythm disorders.

Participants completed the JSQ-P by rating on a 6-point intensity Likert scale, in which a score of 6 referred to strongly agree/true/applicable and 1 referred to strongly disagree/agree/false/inapplicable. Higher scores indicated greater signs of sleep disorders or deleterious sleep habits with the exception of two items, which served as reverse items to confirm response consistency and respondents' correct understanding of both syntax and rating method. Reversed items were rescored prior to analysis.

2.3. Procedure

In the clinical group, clinicians handed out questionnaires, which were collected onsite from the guardians following completion. In the community group teachers or nurses distributed the questionnaires, which were collected onsite from the guardians following completion. All submitted surveys remained completely anonymous and did not include any personal information that might identify the respondent or their child.

2.4. Statistical analysis

Descriptive statistics were completed for patient demographics and basic sleep parameters such as total sleep time and sleep-onset latency. Although the JSQ-P already was structured by EFA in a small sample study, we reevaluated its factor structure and reliability in this larger study population. The factorability of the data was supported by a highly significant Bartlett's test of sphericity and a Kaiser–Meyer–Olkin test of sampling adequacy values exceeding the minimum recommended value of 0.60 [30]. As in our previous study, EFA was used. Maximum likelihood factoring was used to extract the previous factors, followed by an oblique rotation of previous factors using varimax rotation due to the non-orthogonal structure of interrelated sleep problem items [31]. The number of previous factors to be retained was guided by two decision rules: Kaiser's [32] criterion (eigenvalues above 1) and inspection of the scree plot [33]. We chose a factor structure with a primary factor loading of 0.3 or above and no cross-loading of 0.3 or above. This criterion generally is acceptable, but it is not preferable. However, Kline [34] mentioned in 2002 that variables with a loading of magnitude 0.3 or greater are considered to have a significant influence on the factor, especially in large samples such as that of our published study. We only included cases in the EFA with complete data. The reliability of the resulting subscales was assessed using Cronbach α coefficient [35]. The validity of the newly developed JSQ-P was confirmed by comparing the community and clinical groups using an analysis of covariance, assessing age and schooling status. We tested the ability of the JSQ-T to detect differences in the clinical group. These participants were then matched for age and gender with a subsample of the community group, as comparing two groups with such disparate sample sizes is statistically problematic and increases the likelihood of a Type 1 error.

To determine cutoff points of JSQ-P scores, receiver-operating characteristic (ROC) curves were obtained by plotting sensitivity on the *y*-axis against specificity on the *x*-axis using both community and clinical samples and calculating the area under the ROC curve (AUC); an AUC of 1.0 indicated a perfect test and an AUC of 0.5 denoted an unsatisfactory performance. We determined the cutoff points based on the best sensitivity–specificity balance in the ROC curves. We also calculated the proportion of the children above the cutoff criteria in the clinical sample. To ensure comparability and assess score distributions in the population sample, subscale scores were transformed to T score after examining if subscale scores were distributed as a standard normal using the Kolmogorov–Smirnov test.

Finally normalized JSQ-P scores were analyzed by age and gender. Comparison of the variables for descriptive purposes was completed using the *t* test, and mean differences between extreme age and gender groups were calculated. A P value <.05 was considered statistically significant. All statistical analyses were performed using SPSS version 20 (Chicago, IL, USA).

3. Results

Of 3060 individuals enrolled in our study 136 (4.4%) were excluded due to age, as the JSQ-P was developed for children between the ages of 2 and 6 years (prior to elementary school). Furthermore, invalid responses such as missing information and zero variance of 39 items also were excluded. In the final analysis, 2693 subjects were included in the community sample and 89 in the clinical sample (Fig. 1). There were no significant demographic differences between excluded individuals and the final community and clinical samples.

Descriptive statistics are shown in Table 1. There were 1471 boys and 1220 girls in the community sample and 53 boys and 36 girls in the clinical sample. There was no statistical significance in gender ratio (χ^2 test, 0.83; $P = .21$). The average ages were statistically significant at 50.7 and 56.0 months in the community and clinical samples, respectively (*t* test, 3.98; $P < .01$). In the community sample, 63.1% attended a nursery school, 6.4% were in kindergarten, 2.6% enrolled in other schools such as temporary preschools or cram schools, and 26.9% did not attend any school. In contrast, children attending kindergarten accounted for approximately 50% in the clinical sample. The average total sleep durations were 9.76 and 9.99 h in the community and clinical samples, respectively (*t* test, 1.67; $P = .10$). There was no statistically significant difference in sleep-onset latency between the two groups.

Both measures of psychometric adequacy suggested that the correlation matrix was appropriate to the factor model: Bartlett's test of sphericity indicated that the items were interdependent (χ^2 test, 36651.85; $P < .001$). The Kaiser–Meyer–Olkin measure of sampling adequacy was 0.878. The EFA revealed 10 underlying factors of the JSQ-P with eigenvalues above 1. The scree plot also indicated that 10 previous factors should be retained. The results exhibited a simple structure with clearly defined factors. Items were classified into 10 subscales, which was the same interpretation as previously reported [28] (Factor I, RLS sensory; Factor II, OSAS; Factor III, morning symptoms; Factor IV, parasomnias; Factor V, insomnia or circadian rhythm disorders; Factor VI, daytime excessive sleepiness; Factor VII, daytime behaviors; Factor VIII, sleep habit; Factor IX, insufficient sleep; and Factor X, RLS motor). These 10 factors accounted for 63.01% of the variance (Table 2).

The Cronbach α coefficients are listed in Table 3. The internal consistencies of the entire JSQ-P were 0.86 and 0.86 for the community and clinical samples, respectively. The Cronbach α coefficient for subscales ranged from 0.62 to 0.91 and from 0.70 to 0.96 in the community and clinical samples, respectively. Unadjusted mean and standard deviations also are presented in Table 3. We compared the community and clinical samples for each subscale of the newly developed JSQ-P. An analysis of covariance with covarying age and schooling status indicated that the clinical group had higher scores (worse) than the community sample on Factor II (OSAS), Factor III (morning symptoms), Factor IV (parasomnias), Factor VI (daytime excess sleepiness), and Factor VII (daytime behaviors). There were no significant differences in the five of the subscales (Factor I, RLS sensory; Factor V, insomnia or circadian rhythm disorders; Factor VIII, sleep habit; Factor IX, insufficient sleep; and Factor X, RLS motor). The AUCs of each subscale were calculated to examine sensitivity and specificity. Statistical tests evaluating the null hypothesis or the AUC curve to be 0.5 revealed that the entire JSQ-T scores, Factor II (OSAS), Factor III (morning symptoms), Factor IV (parasomnias), Factor VI (daytime excess sleepiness), and Factor VII (daytime behaviors) were significantly different between the community and clinical samples.

A cutoff point of the total JSQ-P score determined by the intersection of sensitivity and specificity was 84. This cutoff point corresponded to 27.90% of the community sample, with a sensitivity of 0.72 and a specificity 0.72. Similarly the cutoff points of Factor II (OSAS), Factor III (morning symptoms), Factor IV (parasomnias), Factor VI (daytime excess sleepiness), and Factor VII (daytime behaviors) were 21 (sensitivity, 0.85; specificity, 0.84), 9 (sensitivity, 0.52; specificity, 0.54), 9 (sensitivity, 0.55; specificity, 0.61), 7 (sensitivity, 0.64; specificity, 0.62), and 6 points (sensitivity, 0.49; specificity, 0.64), respectively. The remaining domains did not have sufficient discriminative power based on ROC analysis. Hence we determined cutoff points using the expert opinion of two specialists in pediatric medicine, a nurse who specialized in pediatric health and a statistician. The proportions of the children above the cutoff point criteria in the clinical sample were high (>70%) in Factor II (OSAS) and Factor VIII (sleep habit); scores were

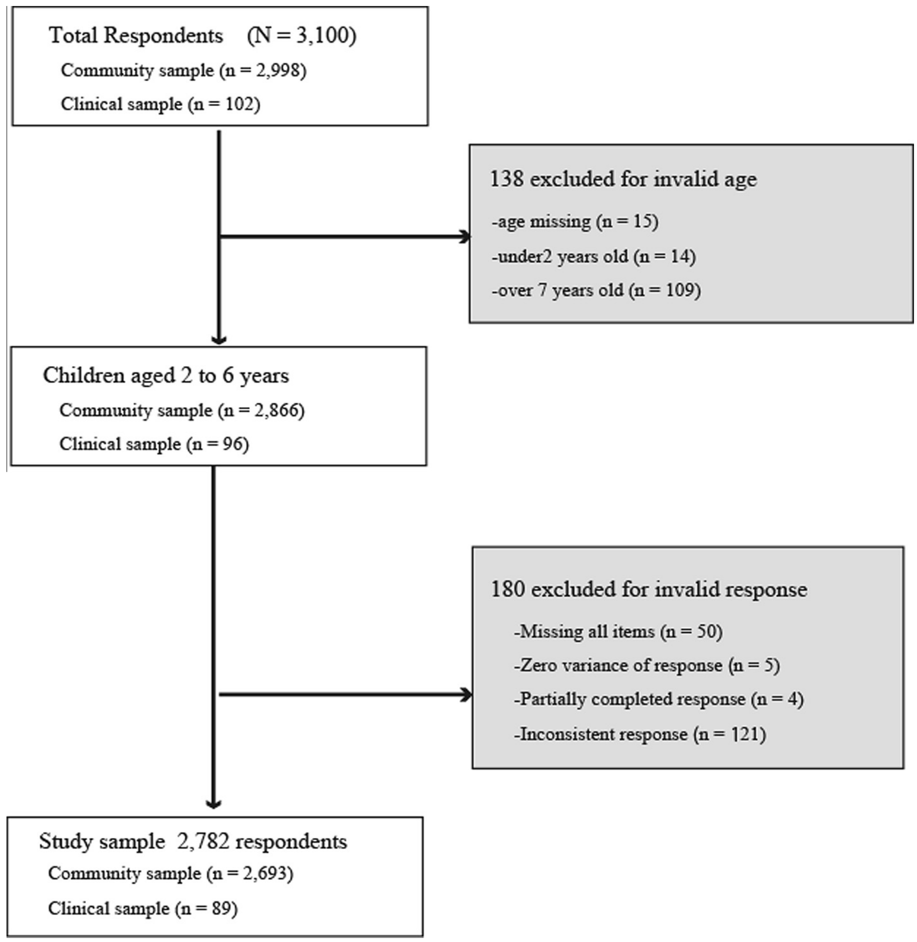

Fig. 1. Selection of the study sample. Of 3100 responses, 138 were excluded due to missing or invalid ages of less than 2 years or more than 7 years. In addition, we excluded 180 invalid responses. Of the participants who provided invalid responses, 50 did not answer all the Japanese Sleep Questionnaire for Preschoolers (JSQ-P) items, five provided the same values for all JSQ-P items, four stopped answering halfway through the questionnaire, and 121 gave contradictory answers for "Sleeps without being tucked in" and "Has trouble getting to sleep." In total 2782 respondents were included in the study analysis.

Table 1
Participant characteristics.

Variables	n (%)	
	Community sample	Clinical sample
Sex		
Boy	1471 (54.62%)	53 (59.55%)
Girl	1220 (45.30%)	36 (40.45%)
Unknown	2 (0.08%)	0 (0.0)
Age		
Age (mo), mean ± SD	50.67 ± 12.38	56.02 ± 15.46
Schooling status		
Not attending	725 (26.92%)	12 (13.48%)
Nursery school	1699 (63.09%)	27 (30.34%)
Kindergarten	172 (6.39%)	44 (49.44%)
Other school	71 (2.64%)	6 (6.74%)
Unknown	26 (0.97%)	0 (0.00)
Sleep duration		
mean ± SD	9.76 ± 0.82	9.99 ± 1.32
<10 h	1306 (48.50%)	24 (26.97%)
⩾10 h	1378 (51.17%)	65 (73.03%)
Unknown	9 (0.33%)	0 (0.00)
Sleep-onset latency		
<30 min	2258 (83.85)	75 (84.27%)
⩾30 min	406 (15.10)	14 (15.73%)
Unknown	29 (1.10)	0 (0.00)

Abbreviations: mo, months; SD, standard deviation; h, hours; min, minutes.

moderate in Factor III (morning symptoms), Factor IV (parasomnias), Factor VI (daytime excessive sleepiness), and Factor VII (daytime behaviors); and scores were in low (<40%) in Factor I (RLS sensory), Factor V (insomnia or circadian rhythm disorders), Factor IX (insufficient sleep), and Factor X (RLS motor).

The percentile T scores were calculated in all subscales, as the normality of all items was rejected by the Kolmogorov–Smirnov test. Table 4 presents the norm conversion table for transforming JSQ-P subscale scores into percentile ranks and standardized T scores. For example, when the sum of seven items forming the OSAS subscale is 7, it can be converted into a percentile rank of 6 and a T score of 34.0. In the community sample, this child would have a OSAS score lower than 6% of all preschool children in the population-based sample and be ranked below the mean (T scores, 50.0) in the community sample. Because the standard deviation was 10.0, this child would be slightly more than 1 standard deviation below the mean in the community sample. Considering all the subscales, the 70th percentile of the two RLS-related subscales was extremely skewed to the left.

Table 4 presents the distribution of normalized scores in the community sample by gender and age. A significant difference in gender was observed, with boys scoring higher on Factor VII (daytime behaviors) regardless of age. In Factor III (morning symptoms), Factor IV (parasomnias), and Factor IX (insufficient sleep), girls scored higher than boys at an older age. However, girls had lower OSAS scores compared to boys at a younger age. Score

Table 2
Varimax-rotated factor structure of the Japanese Sleep Questionnaire for Preschoolers.

Item number	Factor loading									
	I	II	III	IV	V	VI	VII	VIII	IX	X
Factor I Restless legs syndrome, sensory										
Q14	0.844									
Q15	0.577									
Q16	0.893									
Factor II obstructive sleep apnea syndrome										
Q11		0.310								
Q29		0.323								
Q30		0.584								
Q31		0.570								
Q32		0.743								
Q33		0.708								
Q34		0.720								
Factor III morning symptoms										
Q1			0.749							
Q2			0.911							
Q3			0.802							
Factor IV parasomnias										
Q25				0.802						
Q26				0.699						
Q27				0.576						
Q28				0.433						
Q37				0.508						
Factor V insomnia or circadian rhythm disorders										
Q4					0.411					
Q5					0.313					
Q12					0.327					
Q13					0.483					
Q19					0.439					
Q20					0.393					
Q22					0.410					
Q23					0.377					
Q38					0.451					
Q39					0.522					
Factor VI daytime excessive sleepiness										
Q6						0.390				
Q9						0.737				
Q10						0.715				
Factor VII daytime behaviors										
Q7							0.849			
Q8							0.792			
Factor VIII sleep habit										
Q21*								0.786		
Q24*								0.783		
Factor IX insufficient sleep										
Q35									0.693	
Q36									0.661	
Factor X restless legs syndrome, motor										
Q17										0.809
Q18										0.782
Eigenvalues	8.56	2.94	2.52	2.16	1.83	1.63	1.49	1.34	1.12	1.08
Cumulative contribution ratio	21.95	29.48	35.95	41.49	46.18	50.37	54.18	57.62	60.50	63.01

The item details are showed in Table 4.
* Reverse item.

differences between age groups at both ends (2–3 years vs 5–6 years) were found in Factor II (OSAS), Factor III (morning symptoms), Factor IV (parasomnias), Factor VIII (sleep habit), and Factor IX (insufficient sleep). Scores for Factor II (OSAS), Factor III (morning symptoms), and Factor IX (insufficient sleep) increased (worsened) with age, whereas Factor IV (parasomnias) and Factor VIII (sleep habit) decreased (improved) with age.

4. Discussion

Our study describes the psychometric properties of a screening questionnaire that was designed to assess preschool-aged sleep disturbances and problematic behaviors in Japan. In our large population-based sample, we found a similar factor structure, number of factors, and interpretation compared to the previously reported JSQ-P. In addition, the internal consistency coefficients of the newly developed JSQ-P were near or above acceptable standards of 0.70 [36]. Moreover, the face validity of the JSQ-P was confirmed through expert review. These results strongly suggest the structural robustness of the JSQ-P.

There are several important findings from the results of the factor structure. First, RLS was divided into two subscales, sensory and motor, to reflect the characteristics of preschool children. The ICSD-2 proposed different diagnosis criteria for adults and

Table 3
Reliability and validity of the Japanese Sleep Questionnaire for Preschoolers.

Subscales	Community sample				Clinical sample				ANCOVA[‡]		% of the children who meet above criteria in clinical sample
	Cronbach α	Mean	SD	n	Cronbach α	Mean	SD	n	F	P value	
I Restless legs syndrome, sensory	0.848	4.29	2.279	66	0.881	3.87	1.953	66	1.228	.270	36.90%0
II Obstructive sleep apnea syndrome	0.724	27.05	7.109	66	0.712	14.9	5.585	66	113.332	**<.001**	80.49%
III Morning symptoms	0.888	9.23	3.894	66	0.908	7.8	4.187	66	3.944	**.049**	55.60%8
IV Parasomnias	0.784	9.91	4.526	66	0.839	8.23	3.575	66	5.328	**.023**	58.62%
V Insomnia or circadian rhythm disorders	0.748	17.62	5.935	66	0.786	17.15	6.658	66	0.180	.672	31.65%
VI Daytime excessive sleepiness	0.738	6.92	2.797	66	0.756	5.57	2.225	66	8.971	**.003**	57.14%
VII Daytime behaviors	0.877	5.18	2.286	66	0.843	4.41	2.347	66	3.671	**.058**	48.28%
VIII Sleep habit[†]	0.766	6.36	2.896	66	0.719	7.02	3.074	66	1.518	.220	83.91%
IX Insufficient sleep	0.622	6.27	2.284	66	0.696	6.51	2.785	66	0.273	.602	30.34%
X Restless legs syndrome, motor	0.912	2.77	1.497	66	0.959	2.57	1.372	66	0.607	.437	31.40%
Male gender		1.44	0.5	66		1.39	0.493	66	0.272	.603	
Age (mo)		57.95	15.58	66		60.33	13.468	66	0.837	.362	

Abbreviations: ANCOVA, analysis of covariance; AUC, area under the receiver operating characteristic curve; SD, standard deviation; mo, months.
We have confirmed the validity of Japanese Sleep Questionnaire for Preschoolers by using an age- and gender-matched subsample of the community.
Cronbach α coefficients were calculated by using all data.
The bold value in column 11 shows a significance level of $P < 0.1$.
[†] The direction of score is opposite due to reverse items.
[‡] Covarying age and schooling status.

children, as children may not complain of sensory symptoms without prompting [37]. Therefore, RLS items may split into the motor symptoms, which guardians can objectively observe, and the sensory ones, which children may not complain of without being asked. Second, the JSQ-P categorized sleep-associated problems in the daytime into Factor III (morning symptoms), Factor VI (daytime excess sleepiness), and Factor VII (daytime behaviors); whereas these items were grouped into the same domain of daytime sleepiness in the CSHQ. In pediatric OSAS, children often do not have cortical arousals in response to the upper airway obstruction, and sleep architecture usually is normal because of this higher arousal threshold. This finding may explain why excessive daytime sleepiness is less common in children than in adults with OSAS (ISCD-2). In contrast, daytime hyperactivity and impulsivity, which were categorized as Factor II (daytime behaviors), frequently are observed in children with OSAS [37]. Therefore, these three items seen in the daytime may correspond to the different sleep pathology. Moreover, it would be reasonable to use an intensity rating scale, as items such as restlessness and poor concentration are difficult to judge based on frequency. Third, it is worth noting that sleep bruxism was classified into OSAS. Some studies have reported the association between sleep-related bruxism and OSAS [38,39]; however, other studies have not found such an association [40,41]. Thus the association of bruxism and OSAS remains to be clarified.

The criterion-related validity of the newly developed JSQ-P was confirmed for Factor I (RLS sensory), Factor II (OSAS), Factor III (morning symptoms), Factor IV (parasomnias), Factor VI (daytime excessive sleepiness), Factor VII (daytime behaviors), and Factor X (RLS motor). However, we could not demonstrate the validity for Factor V (insomnia or circadian rhythm disorders), Factor VIII (sleep habit), and Factor IX (insufficient sleep). Given the high prevalence of poor sleep hygiene in Japan (e.g., short sleep duration, later sleep onset), these results are not surprising. The broad range of JSQ-P scores in the community sample suggested that there may be many children with poor sleep hygiene in this group.

Our study also reported gender- and age-specific distributions in the community sample of children ages 2–6 years in Japan. The strong associations between sleep habit, parasomnias, and insomnia or circadian rhythm disorders with age are consistent with a previous study [42]. Our study corroborates a high prevalence of OSAS in older children and in boys. Similarly parasomnia was more commonly found in younger children and in girls. Furthermore, daytime behaviors among boys were consistently higher than among girls, consistent with the higher prevalence of attention-deficit/hyperactivity disorder in boys. These score distribution findings may be useful in clinical and research settings.

Our study had several limitations. First, recruitment was restricted to urban areas and facilities, and socioeconomic status was not directly asked but only was indirectly inferred. Second, there may be a bias from the guardians reporting their children's sleep habits. Because the JSQ-P relies solely on the guardians' recognition of their children's sleep problems, any under- or overperception can lead to a bias. In addition, retrospective biases also may exist. Further research is required to examine the retest reliability of the JSQ-P. In addition to these limitations, the results of the EFA should be considered in light of what is known about the value of trivial factors, as four factors (Factor VII, daytime behaviors; Factor VIII, sleep habit; Factor IX, insufficient sleep; and Factor X, RLS motor) only have two items loaded with each only explaining a further 2–3% of the total variance. Specifically, the finding that there was a high correlation between two items of RLS motor raises the possibility that these two items are not statistically independent. In a discussion with a pediatrician, we confirmed that the two items that comprise RLS motor had a different nuance regarding observations of behavior; these issues will be carefully considered in our future research.

Despite these limitations, our study had several strengths. First, we proposed an instrument that is appropriate for Japanese sleeping conditions and sleep culture. It is worth noting that the JSQ-P does not have a factor related to sleep resistance. We demonstrated differences with the Western culture. Second, our findings are based on a large and unselected Japanese population of preschool children. Sampling was conducted from multilevel stratified classes of Japan. Hence we were able to demonstrate distributional characteristics of normalized scores. In addition, a large sample allowed for an adequate analysis even after excluding missing and invalid responses, which frequently occur in questionnaire-based

Table 4
Distribution of Japanese Sleep Questionnaire for Preschoolers standardized T scores by age and gender in the community sample.

Subscales	Gender- and age-specific distribution				P value[†,‡]
	All ages	2–3 y	4 y	5–6 y	
I Restless legs syndrome, sensory					
All		49.54 ± 9.73	50.79 ± 10.45	49.88 ± 9.87	.499
Boy	49.77 ± 9.83	49.39 ± 9.59	50.41 ± 10.26	50.06 ± 9.94	.388
Girl	50.1 ± 10.09	49.73 ± 9.89	51.27 ± 10.68	49.66 ± 9.80	.754
P value[†,*]	.392	.507	.289	.646	
II Obstructive sleep apnea syndrome					
All		49.12 ± 9.66	49.76 ± 10.03	50.54 ± 9.63	.004
Boy	50.16 ± 9.91	49.87 ± 9.85	50.54 ± 10.34	50.5 ± 9.52	.027
Girl	48.82 ± 9.52	48.18 ± 9.33	48.88 ± 9.58	50.6 ± 9.78	<.001
P value[†,*]	<.001	.001	.035	.905	
III Morning symptoms					
All		48.36 ± 9.7	51.67 ± 10.15	52.09 ± 9.84	<.001
Boy	49.51 ± 9.87	48.22 ± 9.73	51.59 ± 10.05	50.64 ± 9.46	<.001
Girl	50.33 ± 10.12	48.51 ± 9.66	51.74 ± 10.30	53.8 ± 10.03	<.001
P value[†,*]	.035	.565	.841	<.001	
IV Parasomnias					
All		51.05 ± 9.99	48.96 ± 9.77	47.41 ± 9.53	<.001
Boy	49.35 ± 9.86	50.69 ± 9.84	48.34 ± 9.63	46.68 ± 9.55	<.001
Girl	50.44 ± 10.02	51.48 ± 10.14	49.76 ± 9.88	48.28 ± 9.45	<.001
P value[†,*]	.005	.131	.063	.061	
V Insomnia or circadian rhythm disorders					
All		50.16 ± 9.9	50.36 ± 10.4	48.94 ± 9.5	.020
Boy	49.95 ± 9.95	50.01 ± 10.01	50.44 ± 10.36	49.16 ± 9.25	.134
Girl	50.00 ± 9.98	50.36 ± 9.78	50.31 ± 10.45	48.66 ± 9.81	.014
P value[†,*]	.906	.537	.873	.560	
VI Daytime excessive sleepiness					
All		49.46 ± 9.94	49.76 ± 9.78	50.6 ± 9.90	.027
Boy	49.99 ± 9.91	49.75 ± 9.99	50.21 ± 9.75	50.4 ± 9.91	.209
Girl	49.48 ± 9.89	49.13 ± 9.89	49.23 ± 9.81	50.85 ± 9.91	.015
P value[†,*]	.190	.233	.200	.618	
VII Daytime behaviors					
All		49.44 ± 9.93	50.21 ± 9.91	50.58 ± 10.10	.026
Boy	50.99 ± 10.06	50.36 ± 10.09	51.75 ± 9.95	51.88 ± 10.03	.012
Girl	48.48 ± 9.68	48.34 ± 9.63	48.39 ± 9.58	49.04 ± 10.00	.436
P value[†,*]	<.001	<.001	<.001	.002	
VIII Sleep habit					
All		51.47 ± 9.65	49.45 ± 10.15	46.41 ± 9.87	<.001
Boy	50.02 ± 9.93	51.41 ± 9.57	49.34 ± 9.84	46.74 ± 10.27	<.001
Girl	50.00 ± 10.08	51.53 ± 9.75	49.64 ± 10.49	46.01 ± 9.38	<.001
P value[†,*]	.964	.806	.710	.405	
IX Insufficient sleep					
All		49.04 ± 9.91	50.63 ± 10.12	51.83 ± 9.87	.018
Boy	50.00 ± 10.00	49.39 ± 10.09	50.65 ± 10.14	51.00 ± 9.43	.018
Girl	49.91 ± 10.03	48.62 ± 9.68	50.56 ± 10.08	52.82 ± 10.30	<.001
P value[†,*]	.814	.137	.908	.038	
X Restless legs syndrome, motor					
All		49.77 ± 9.84	50.49 ± 10.31	49.64 ± 9.75	.8
Boy	49.95 ± 9.93	49.83 ± 9.86	50.61 ± 10.33	49.46 ± 9.61	.553
Girl	49.90 ± 9.97	49.70 ± 9.82	50.37 ± 10.33	49.85 ± 9.94	.935
P value[†,*]	.882	.800	.763	.653	

Abbreviation: y, years.
Values denote mean ± standard deviation unless specified otherwise.
The mean ± standard deviation in all participants was 50.00 ± 10.00.
[†] Significance of the trend, analyzed by *t* test.
[‡] Difference in means between two age groups (2–3 y vs 5–6 y).
[*] Difference in means between genders.

surveys. In our study, 10% of the initial sample was excluded, due to missing values or inconsistent responses. Although invalid responses frequently occur and may be easily excluded in observational studies by performing pairwise analysis, we suggest that deliberate consideration is required. Third, we presented the distribution of scores by basic characteristics. Most instruments used to assess sleep habits and disturbances reported a total score or subscale scores without considering gender or age. However, a profile with an unspecified reference range will likely be difficult to apply in a clinical setting such as a physical examination.

In summary, the JSQ-P was developed to address the practical needs to screen for sleep disorders and problematic sleep behaviors among preschool-aged Japanese children. In our study, we found that the JSQ-P was a reliable and valid measure in a large sample and was well-suited for the Japanese sleep culture. The JSQ-P utilizes an easy to answer approach, requires only 15 min to complete, and involves simple calculations for its subscale scores. In addition to its robust psychometric properties, these qualities strongly support the use of the JSQ-P in both clinical and research settings.

Conflict of interest

The ICMJE Uniform Disclosure Form for Potential Conflicts of Interest associated with this article can be viewed by clicking on the following link: http://dx.doi.org/10.1016/j.sleep.2013.05.020.

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Appendix A. Supplementary data

Supplementary data associated with this article can be found, in the online version, at http://dx.doi.org/10.1016/j.sleep.2013.05.020.

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